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Pseudococcid mealybug (Hemiptera: Pseudococcidae) complex of bamboo in Indonesian Sunda Shelf with two new species records

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Abstract

In this study, a survey for determining the pseudococcid mealybug (Hemiptera: Coccomorpha: Pseudococcidae) complex of bamboo was conducted in several provinces in Sumatra and Java Island-Indonesia, a part of Indo-Asian regions. The research collected 85 mealybug specimens consisting of five species within 4 genera namely *Antonina* Signoret (2 species), *Chaetococcus* Maskell (1 species), *Dysmicoccus* Ferris (1 species), and *Palmicultor* Williams (1 species). *Antonina pretiosa* Ferris and *Dysmicoccus zeynepae* are newly recorded for the Indonesian Sunda shelf. The identification key of Indonesian bamboo mealybugs and their distribution data are also updated.

Key words: Coccomorpha, host plant, pests, Sternorrhyncha, taxonomy

Introduction

As a mega biodiversity country, Indonesia is influenced by Asian and Australian biodiversity. In fact, at the beginning of the ice age, the western part of Indonesia such as Bali, Java, Kalimantan and Sumatra merged with the Asian continent (Sunda shelf), while the eastern part of Indonesia was integrated with the Australian continent (Sahul shelf) (Lohman *et al*. 2011). The high diversity of flora and fauna, including insect species, is a result of unique geological and evolutionary history in combination with the wide variety of habitats associated with its many islands (Arifin & Nakagoshi 2011). Nevertheless, the geographic dimension of Indonesian biodiversity, in particular, species endemicity across geographical gradients, has not been taken into account.

A plant genus within a high diversity is bamboo (*Bambusa* sp.), woody perennial evergreen plants belonging to the family Poaceae, consisted of over 590 species in 44 genera (Dransfield & Widjaya 1995). Bamboo is one of the important exporting agricultural material products over the world. This plant is commonly used as pulp for paper mills, houses material, handicrafts, food product items and other people's daily lives (Fu *et al.* 2000).

Whilst bamboo is one of leading agricultural products in the world, the growing as well as the exporting process faces many problems, including insect pest infestations (Thanh *et al.* 2007). There are more than 400 insect species feeding on bamboos within which about 100 species gaining pest status, including mealybugs that can cause heavy damage to the plant (Hemiptera: Coccomorpha: Pseudococcidae) (Kalshoven 1981; Gracia Morales *et al*. 2016). Pseudococcidae is the second-largest family in Coccomorpha after Diaspididae. As one of the important insect pests worldwide, mealybugs play significant roles in transmitting virus, spreading among plants in intra-inter specific relations (Ben-Dov 1994). Scale insects are often become subjects of intercepted alien species in many countries due to the small, persistent, and tiny characters of them (Williams 2004; Kaydan *et al*. 2015).

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In general, there are 2,041 mealybug species in 259 genera worldwide within which 109 species from 32 genera shutteled in Indonesia (García Morales *et al*. 2016; Zarkani *et al*. 2021, 2023). In fact, about 44 Pseudococcid species lives on bamboo in which 10 species (6 genera) namely *Antonina graminis* (Maskell), *Antonina milleri* Williams, *Antonina pretiosa* Ferris, *Antonina thaiensis* Takahashi, *Antonina zonata* Green, *Chaetococcus bambusae* (Maskell), *Extanticoccus javanensis* Williams, *Hordeolicoccus nephelii* (Takahashi), *Palmicultor lumpurensis* (Takahashi), and *Paracoccus interceptus* Lit are already existed in Indonesia (Williams 2004; Garcia Morales *et al.* 2016; Sartiami *et al.* 2016; Zarkani *et al*. 2021).

For the last decades, the study of bamboo mostly focused on genetic variability, chemical contains, and their utilities in agriculture as well as in medical sectors, but a few studies in insect faunal diversity. This study listed bamboo-feeding pseudococcids in the Sunda Shelf including new fauna records, as well as updated identification key of mealybug complex of bamboo in Indonesia.

Material and methods

Mealybug specimens were collected from a series of sampling occasions on leaves, trunks, branches, and roots in bamboo trees in Bengkulu Province, West Sumatra Province, and South Sumatra Province, Indonesia from March to December 2022. The sampling sites are at an altitude of 0 – 1000 m above sea level. The specimens were mounted and preserved in slides and identified to genus. The slide mounting was carried out by preserving the adult female specimens under a binocular dissection microscope, LEICA EZ4HD using Kosztarab and Kozár (1988) methods.

Species identifications were made by observing the specific features of the mealybug species, including body size, shape, and color, using a phase-contrast compound microscope (LEICA DM2700) and were identified using the keys in Williams and Watson (1988), Williams and Granara de Willink (1992), and Williams (2004). The morphological parameters used are those used by Williams and Granara de Willink (1992) and Williams (2004). Specimens are deposited in the Mealybugs Museum, Department of Plant Protection, Faculty of Agriculture, University of Bengkulu, Bengkulu, Indonesia (MMUB).

Results and Discussion

The research collected 85 mealybug specimens in Indonesian Sunda shelf regions consisted of 5 species within 4 genera. The identified species belong to the genus *Antonina* Signoret (2 species), *Chaetococcus* Maskell (1 species), *Dysmicoccus* Ferris (1 species), *Palmicultor* Williams (1 species). *Antonina pretiosa* Ferris and *Dysmicoccus zeynepae* are newly recorded for Indonesian Sunda shelf and marked with a plus mark (+). In addition, the species marked with an asterisk (*) are legless mealybugs.

Identification key to adult females of pseudococcid mealybug (Hemiptera: Pseudococcidae) complex of bamboo trees in Indonesia (11 species), adapted from Williams and Watson (1988), Williams and Granara de Willink (1992) and Williams (2004).

Identification key to adult females of pseudococcid mealybug complex of bamboo trees in Indonesia

1(0)	Legs present	7
-	Legs absent	2
2(1)	Anal ring normally situated on body surface or at base of very short tube, bearing at least 6 setae. Venter with duct-like pores in a group posterior to each second spiracle. Ventral disc-like pores absent from abdomen	*Chaetococcus bambusae* Maskell
-	Anal ring situated at base of anal tube, normally bearing 6 setae (rarely without setae). Venter without duct-like pores posterior to each second spiracle, but disc-like pores or very short, button-like microtubular ducts present in this position, sometimes also in a wider distribution on sub median to submarginal areas of abdomen	3
3(2)	At least posterior segments of abdomen plate-like, at maturity becoming sclerotized from body margin to medial or sub medial areas. Trilocular pores, in profile, as deep as wide	*Antonina pretiosa* Ferris
-	Abdominal segments not plate-like, not becoming sclerotized from medial or sub medial areas. Trilocular pores, in profile, more or less flat	4
4(3)	Multilocular disc pores forming a marginal band around entire body	*Antonina thaiensis* Takahashi
-	Multilocular disc pores not forming a marginal band around entire body	5
5(4)	Disc-like pores present on at least abdominal segments II–IV	*Antonina graminis* (Maskell)

- Disc-like pores present in a single cluster posterior to each second spiracle: if extending onto abdominal segment II, then never present on abdominal segment III and IV 6
6(5) Marginal setae same size as dorsal setae on head and thorax, present between antennae and around rest of body ..... *Antonina milleri* Williams
- Marginal setae much longer than dorsal setae on head and thorax, absent from between antennae but present around rest of body. ..... *Antonina zonata* Green
7(1) Oral rim tubular duct present, each with well-developed rim ..... *Paracoccus interceptus* Lit
- Oral rim tubular duct absent entirely 8
8(7) Each eye associated with sclerotized patch containing discoidal pores, these pores sometimes as large as a multilocular disc pore; other similar disc pores also present, dispersed, at least on venter. Cerarii always numbering 18 pairs ..... *Hordeolicoccus nephelii* (Takahashi)
- If eyes are associated with discoidal pores then these are few, small and inconspicuous. Cerarii numbering 1–17 pairs 9
9(8) Anterior margins of hind coxa indistinct; spiracles and leg bases situated much closer to margin than to midline ..... *Extanticoccus javanensis* Williams
- Anterior margin of hind coxa distinct; spiracles and leg bases situated submedially, about halfway between margin and midline 10
10(9) Derm around hind coxa with numerous minute pores ..... *Palmicultor lumpurensis* (Takahashi)
- Derm around hind coxa without minute pores ..... *Dysmicoccus zeynepae* Zarkani & Kaydan

Antonina Signoret*

Antonina pretiosa Ferris*+ (Fig. 1&6)

Material examined. INDONESIA, Sumatra, Bengkulu Province, Kepahiang district, Kabawetan, on *Bambusa* sp. (Poaceae), 600 m a.s.l, 03°34'54.4" S, 102°35'33" E, 12.vi.2022, coll. A. Zarkani (AZ1080-1081), 6 ♀♀; West Sumatra Province, Padang city, Nanggalo, on *Bambusa* sp. (Poaceae), 100 m a.s.l. 0°54'00.7" S, 100°21'54.1" E, 8.ii.2022, coll. A. Zarkani (AZ700-702), 9 ♀♀. East Sumatra Province, Palembang city, Ilir Barat 1, on *Bambusa* sp. (Poaceae), 230 m a.s.l. 2°58'36.0"S, 104°44'30.2"E, 12.iv.2022, coll. A. Zarkani (AZ880-881), 6 ♀♀.

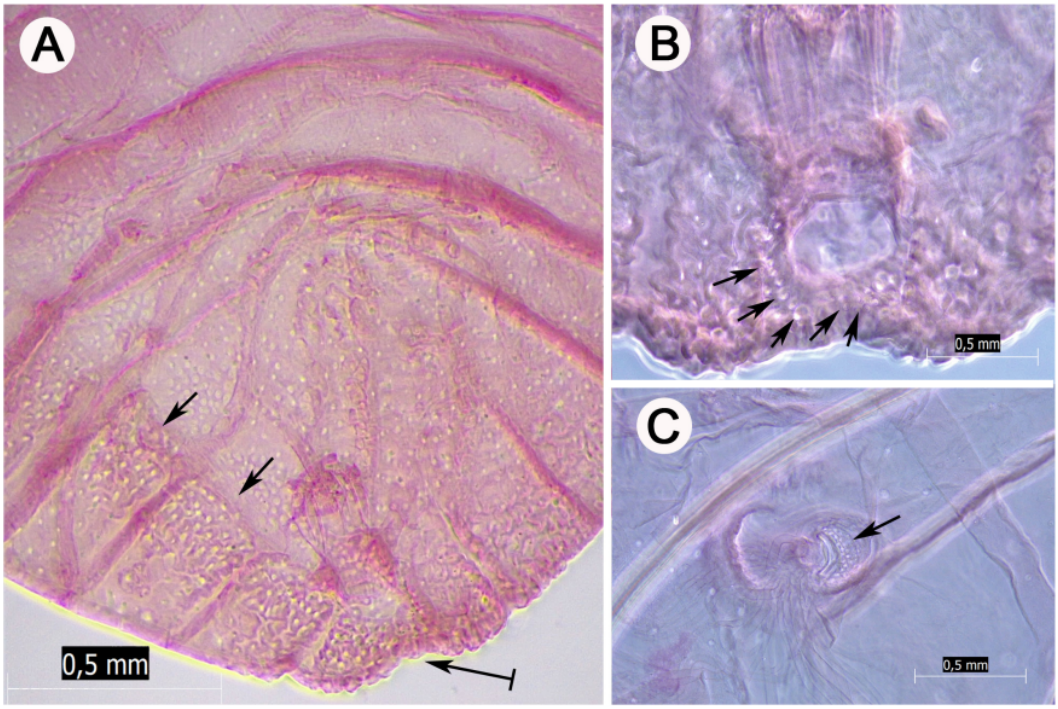

Figure 1. *Antonina pretiosa* Ferris (Hemiptera: Pseudococcidae). **A,** Anal ring situated at base of an anal tube (□), Abdomen plate-like (↓); **B,** Multilocular disc pore restricted to a few, situated lateral to opening of anal tube on dorsum; **C,** Spiracular openings with associated with trilocular pores.

Comments. *Antonina pretiosa* is oligophagous insect species which lives on 6 genera in Poaceaea (García Morales *et al.* 2016; Zarkani *et al.* 2021). The species is easily diagnosed by having disc-like pores in ventral submedian cluster, forming a band from abdominal segment II posteriorly around abdomen. Multilocular disc pores restricted to a few, situated lateral to opening of anal tube on dorsum. The species is widely distributed in the tropical and subtropical zones of the world. In Indonesia, the first record was reported by Gavrilov-Zimin (2013) in Sulawesi, a part of Indo-Australian regions and it has been a new record for Indonesian Sunda shelf.

***Antonina thaiensis* Takahashi* (Fig. 2)**

Material examined. INDONESIA, Sumatra, Bengkulu Province, North Bengkulu district, Arga Makmur town, on *Bambusa* sp. (Poaceae), 300 m a.s.l, 3°26'16.4" S, 102°11'51.1" E, 12.viii.2022, coll. A. Zarkani (AZ1180-1181), 6 ♀♀; East Sumatra Province, Palembang city, Ilir Barat 1, on *Bambusa* sp. (Poaceae), 230 m a.s.l. 2°58'36.0"S, 104°44'30.2"E, 12.iv.2022, coll. A. Zarkani (AZ882-883), 6 ♀♀.

Comments. This is oligophagous species on genus *Bambusa* and *Phragmites* (Poaceae) (García Morales *et al.* 2016; Zarkani *et al.* 2021). In Indonesia, *A. thaiensis* has been recorded previously from Java (Sartiami *et. al.* 2016). It is also found in neighboring countries such as India, Malaysia, Philippines and Srilanka and Thailand (Williams 2004; Gracia Morales *et al.* 2016).

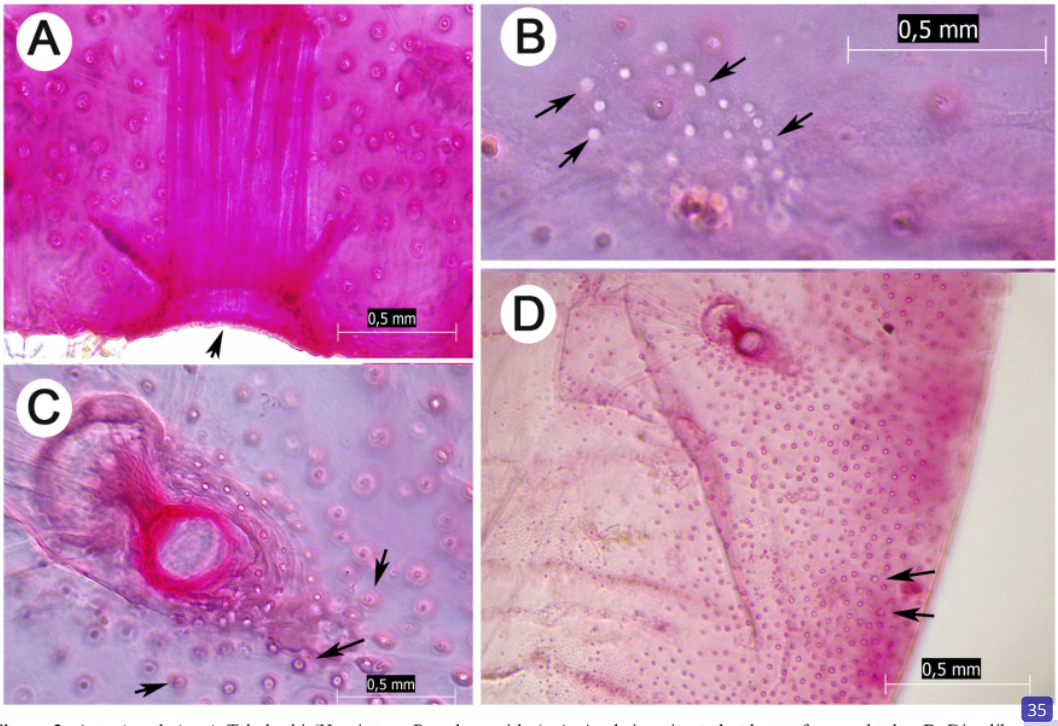

Figure 2. *Antonina thaiensis* Takahashi (Hemiptera: Pseudococcidae). **A,** Anal ring situated at base of an anal tube; **B,** Disc-like pores present on venter of abdomen; **C,** Multilocular disc pore present encircling at least anterior spiracles; **D,** Multilocular disc pores of 1 type only.

***Chaetococcus* Maskell**

***Chaetococcus bambusae* (Maskell)* (Fig. 3)**

Material examined. INDONESIA, Sumatra, Bengkulu Province, Bengkulu Tengah district, Wilayah Kosong, on *Bambusa* sp. (Poaceae), 355 m a.s.l., 3°42'41.4" S, 102°31'33.1" E, 5.iii.2019, coll. A. Zarkani (AZ247), 3 ♀♀. Rejang Lebong district, Sindang Kelingi, on *Bambusa* sp. (Poaceae), 1020 m a.s.l., 3°27'40.8" S, 102°42'40.8" E, 9.viii.2022, coll. A. Zarkani (AZ1001), 3 ♀♀, West Java, Bogor, on *Bambusa* sp. 222 m a.s.l. 6°34'40.0"S, 106°46'30.17"E, 2 ♀♀, 15.xii.2022, coll. D. Sartiami.

Comments. The species is oligophagous that feeds on 10 genera in Poacea (García Morales *et al.* 2016; Zarkani *et al.* 2021). It is a cosmopolitan insect, having been recorded from 44 countries (García Morales *et al.* 2016). In Indonesia, *C. bambusae* has been recorded previously from Flores and Irian Jaya (Gavrilov-Zimin 2013), Java (Sartiami *et al.* 2016) and Sumatra (Williams 2004).

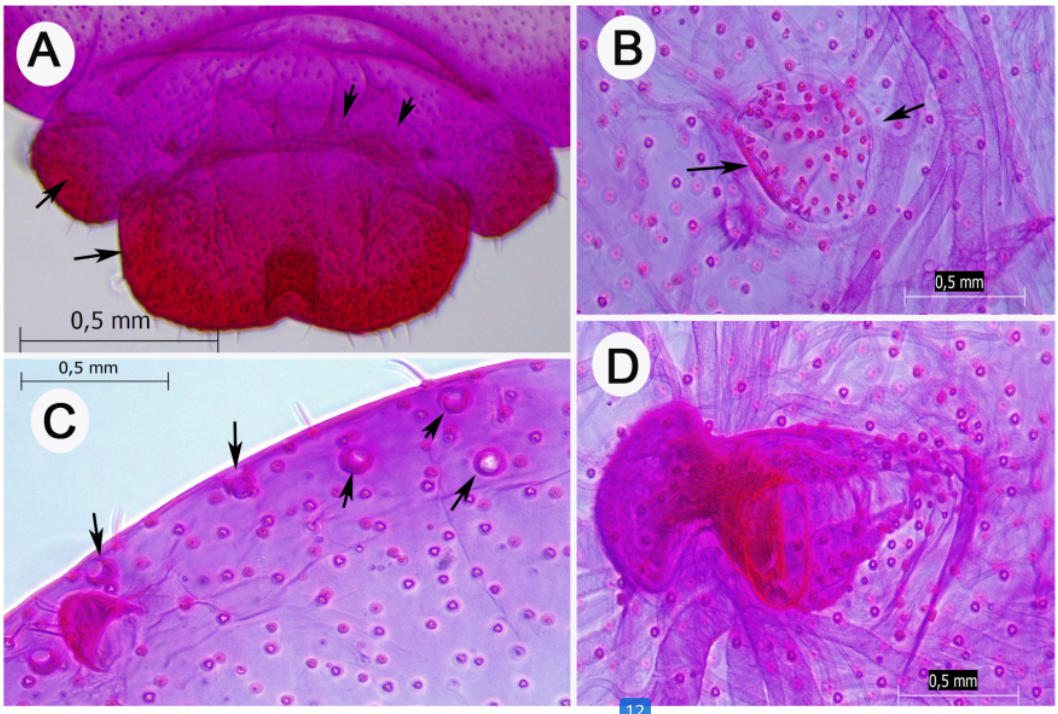

Figure 3. *Chaetococcus bambusae* (Maskell) (Hemiptera: Pseudococcidae). **A,** Multilocular disc pores confined to abdominal segments VII and VIII; **B,** Duct-like pores present on venter in a group posterior to each second spiracle; **C,** Large tubular ducts with collar about two-thirds the length of duct present around head margin; **D,** Spiracles each associated with a crescentic band of small trilocular pores at atrium.

Dysmicoccus Ferris

Dysmicoccus zeynepae Zarkani & Kaydan[+] (Fig. 4 & 7)

Material examined. INDONESIA, Sumatra, Bengkulu Province, Rejang Lebong district, Sindang Kelingi, on *Bambusa* sp. (Poaceae), 1020 m a.s.l., 3°27'40.8" S, 102°42'40.8" E, 9.viii.2022, coll. A. Zarkani (AZ1000), 3 ♀♀. West Sumatra Province, Padang city, Nanggalo, on *Bambusa* sp. (Poaceae), 100 m a.s.l., 0°54'00.7" S, 100°21'54.1" E, 8.ii.2022, coll. A. Zarkani (AZ703), 3 ♀♀.

Comments. *Dysmicoccus zeynepae* Zarkani & Kaydan is polyphagous species complex of *Durio zibethinus* (Malvaceae), *Lansium parasiticum* (Meliaceae), *Manilkara zapota* (Sapotaceae) and *Coffea robusta* (Rubiaceae) (Zarkani *et al.* 2023). The species is closed to *Dysmicoccus finitimus* Williams in having anal lobe and abdominal setae each containing a group of about 2–7 conical setae. However, it is different with some features such as no multilocular disc pores and oral collar tubular ducts on dorsum within a few multilocular disc pores without oral collar tubular ducts on venter. This species is easily recognized by having small legs and translucent pore on hind coxa and femur. This species was recorded on bamboo first time. And also, first *Dysmicoccus* species feeding on bamboo from Indonesia.

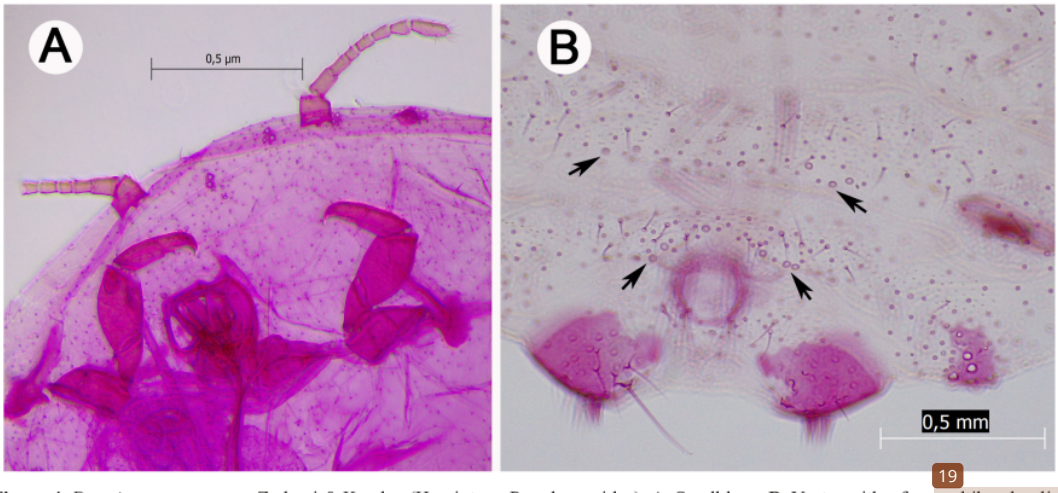

Figure 4. *Dysmicoccus zeynepae* Zarkani & Kaydan (Hemiptera: Pseudococcidae). **A,** Small legs; **B,** Venter with a few multilocular disc pores and oral collar tubular ducts absent from both dorsum and venter.

Palmicultor Williams

Palmicultor lumpurensis (Takahashi) (Fig. 5 & 7)

Material examined. INDONESIA, Sumatra, Bengkulu Province, Kepahiang district, Kabawetan, on *Bambusa* sp. (Poaceae), 600 m a.s.l, 03°34'54.4" S, 102°35'33" E, 12.vi.2022, coll. A. Zarkani (AZ1080-1081), 6 ♀♀; East Sumatra Province, Palembang city, Ilir Barat 1, on *Bambusa* sp. (Poaceae), 230 m a.s.l. 2°58'36.0"S, 104°44'30.2"E, 12.iv.2022, coll. A. Zarkani (AZ884), 3 ♀♀.

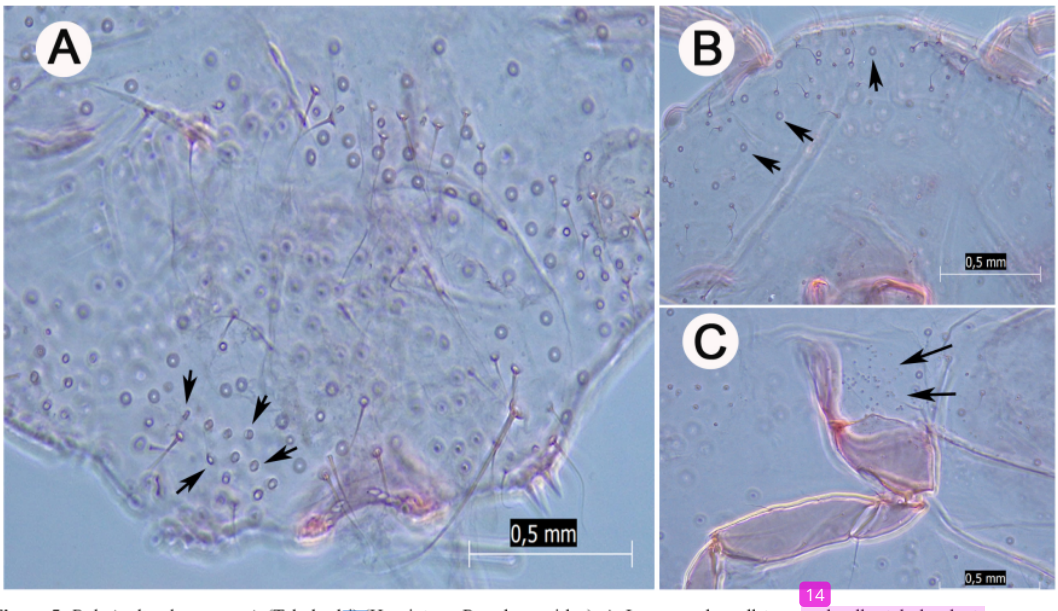

Figure 5. *Palmicultor lumpurensis* (Takahashi) (Hemiptera: Pseudococcidae). **A,** Large- and small-type oral collar tubular ducts numerous on dorsum, present in rows across segments; **B,** Multilocular disc pores numerous around dorsum and venter of head, thorax and abdomen; **C,** Minute duct-like pores present on derm next to hind coxa.

Comments. This is an oligophagous species that feed on 11 genera of plants on Poaceae (García Morales *et al.* 2016; Zarkani *et al*. 2021). It is cosmopolitan, being found in 11 countries spread over all continents. In Indonesia, it has been recorded from Bali (Gavrilov-Zimin 2017) and Irian Jaya (Gavrilov-Zimin 2013). Indonesian specimens of *P. lumpurensis* differ from the illustration Williams (2004) provided by having less multilocular disc pores on the dorsum and the ventral surface (Fig. 7).

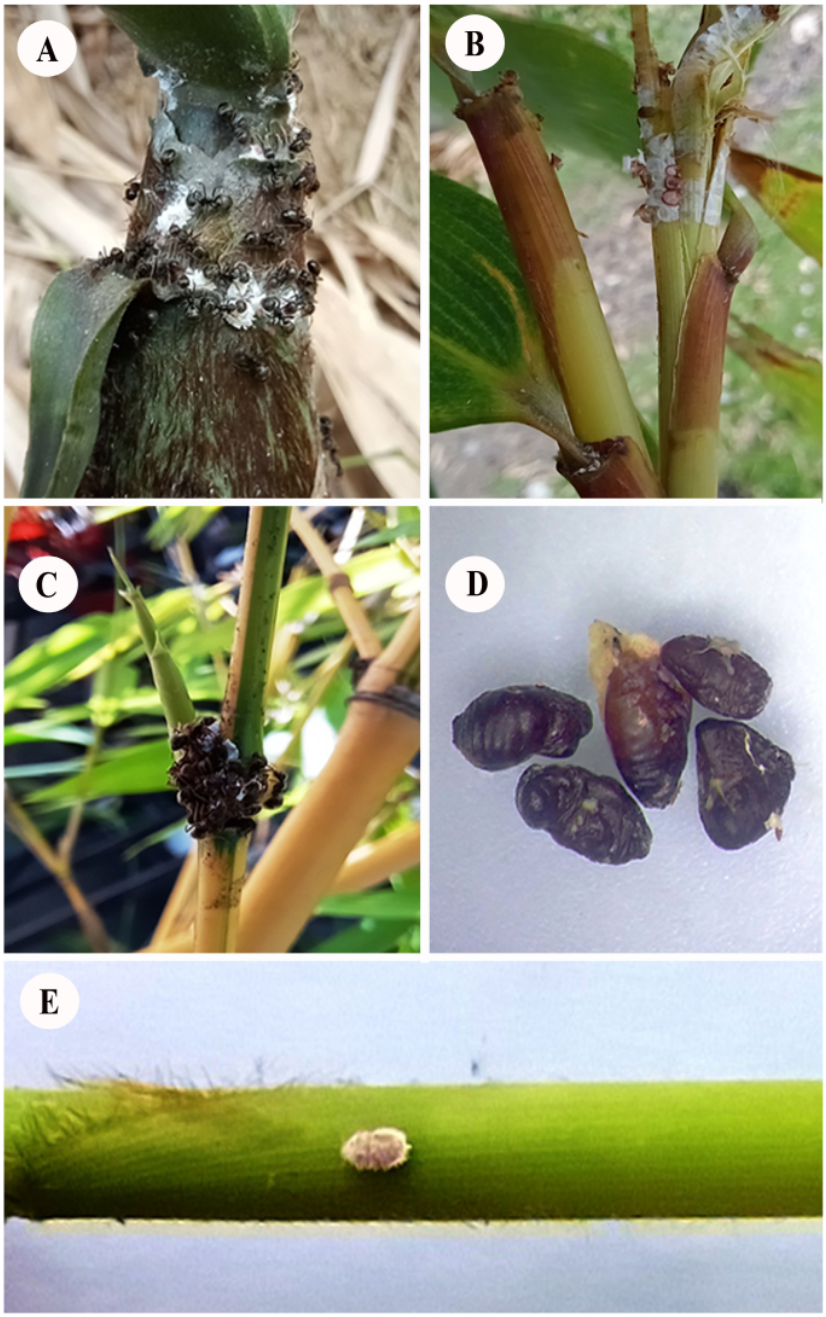

Figure 6. Pseudococcid mealybug (Hemiptera: Pseudococcidae) complex of bamboo trees in Indonesian Sunda shelf regions. **A,** Symbioses among ants and *Dysmicoccus zeynepae* Zarkani & Kaydan; **B,** *Antonina pretiosa* Ferris; **C,** Symbioses among ants and *Antonina thaiensis* Takahashi; **D,** *Chaetococcus bambusae* (Maskell); and **E,** *Palmicultor lumpurensis* (Takahashi).

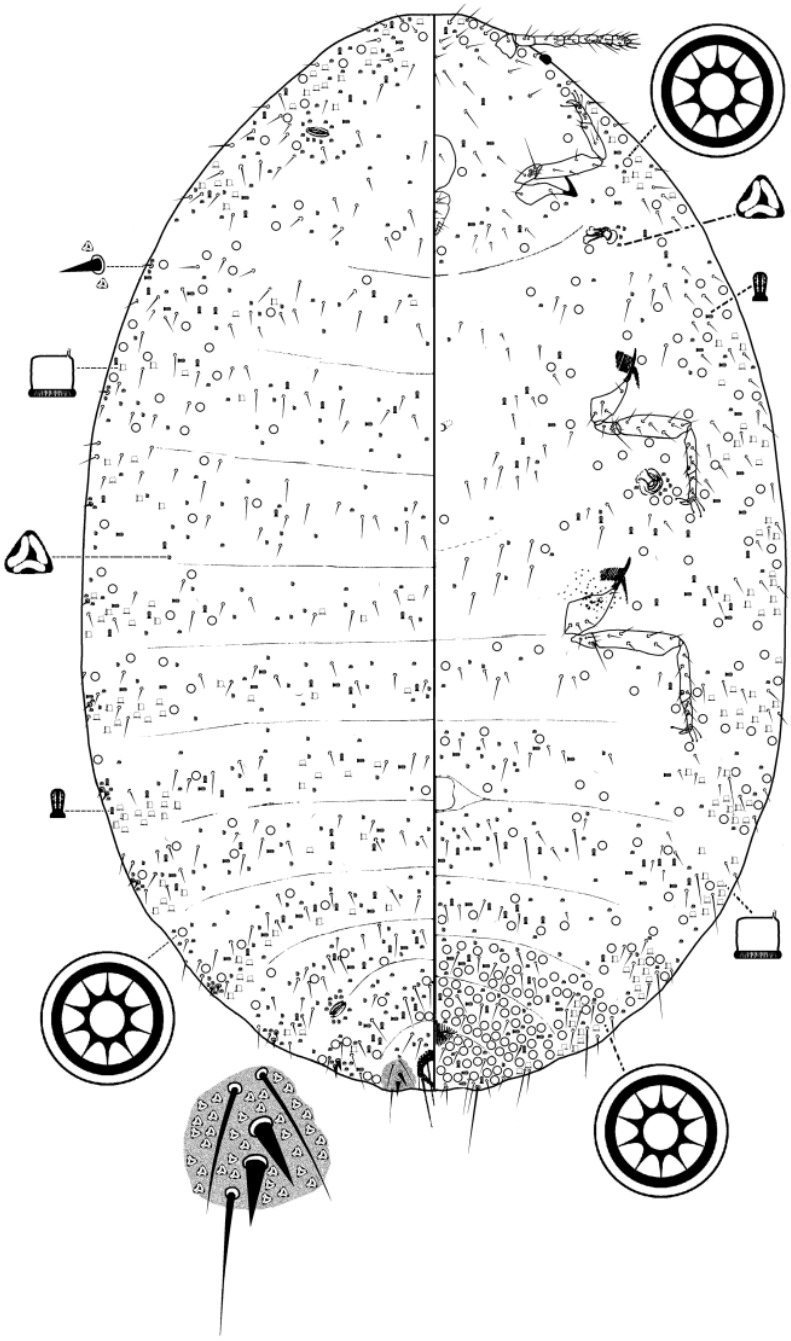

Figure 7. Adult female *Palmicultor lumpurensis* (Takahashi). Specimen from Indonesian Sunda shelf.

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